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WESTERN EQUINE ENCEPHALITIS ANTIBODIES IN MANITOBA BIRDS, 1983

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ABSTRACT

Blood samples of wild birds (mostly house sparrows) were collected during July - September 1983 near communities designated at risk of Western Equine Encephalitis (WEE) infection. Serum samples were analyzed for presence of hemagglutination inhibition antibodies against the virus. Birds which had been in contact with the virus were found in 11 of the 25 sampled communities, including the City of Winnipeg. Antibodies at titres of 1:10 or higher were found in seven percent of all bird samples, eight percent of house sparrow samples. These percentages are somewhat lower than those reported in the literature from other areas subject to WEE outbreaks; however, comparable data for Manitoba from several years are required to correctly assess the extent of the virus activity during 1983 or to judge to what extent the aerial spraying fpr mosquito control contributed to prevent the spread of the infection among the bird hosts. The monitoring of birds can contribute a considerable amount of data from a wide area, and thus furnish the authorities with additional information on which to base decisions regarding the disease control measures.

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INTRODUCTION

The Western equine encephalitis (WEE) is a viral disease that also affects humans. Periodic outbreaks had occurred in Manitoba in the past, most recently in 1977 and 1981; and in July 1983, the Minister of Health declared an emergency in connection with the threat of another such outbreak. Several communities within the Province were considered at risk and subsequently subjected to aerial spraying with malathion in an attempt to prevent spread of the disease by controlling the virus-carrying mosquitoes.

The importance of wild birds in the natural cycle of the virus has been widely acknowledged since the pioneering work of Reeves and Hammon (1962). Birds serve both as reservoir and as amplifying hosts of the virus (Hess and Hayes 1967, Holden et al. 1973a). Monitoring of birds has been used in surveillance programs concerning both the WEE and other arboviral diseases (e.g. Clark et al. 1977, Dorland et al. 1979). Increased virus activity among birds generally suggests increased risk to other hosts, including humans, especially if it occurs simultaneously with a high population of the carrier mosquitoes. Information about high incidence of infection is important to the Health authorities.

This study was initiated by the Terrestrial Standards and Studies Section in order to obtain such information. Analytical support was provided by the Cadham Provincial Laboratory. Because similar surveillance has not been carried out in Manitoba prior to 1983, the objectives of the study were to:

i) ascertain the prevalence of antibodies to WEE among the Manitoba wild birds during 1983;

ii) compare the results with available data from other areas;

iii) establish a baseline that could be used for comparison in the future.

The monitoring was aimed mainly at smaller species, especially the order Passeriformes (perching birds), since birds in this order have been consistently found to be involved in the WEE cycle to a greater extent than were birds in other orders (Hayes and Wallis 1977). Most emphasis was placed on the house sparrows (Passer domesticus) because they have been implicated in studies carried out in other areas (e.g. Holden et al. 1973 a, b; Lord et al. 1974), live in close association with human dwellings, and constitute a large proportion of Manitoba avifauna.

MATERIALS AND METHODS

Birds were caught alive in mist nets placed around granaries and hedgerows in farmyards near the communities designated at risk (Figure 1). In Winnipeg, the nets were located in selected backyards, and in addition, feral pigeons (Columba livia) were caught by hand nets inside buildings and in a corn-baited pigeon trap. Except for the pigeons which were collected in connection with another project, (Kucera 1983) all birds were released after the blood sampling.

For blood collection, the brachial vein was punctured with a syringe needle and the blood was drawn into a Pasteur pipet and transferred into a 0.4 ml polyethylene centrifuge tube. Samples of less than about 0.15 ml were poolod according to species, sex and age.

In total, 351 birds were sampled, 73 percent of them were house sparrows. Pigeons (collected only in Winnipeg) accounted for 11 percent, all other species for 16 percent (Table 1).

Samples were submitted to the Cadham Provincial Laboratory to be tested for antibodies to WEE. The hemagglutination inhibition (HI) method after Sokla and Stackiw (1976) was used; those samples which seroconverted to a 1:10 level or greater were considered positive (carrying antibodies). There were 259 tested samples.

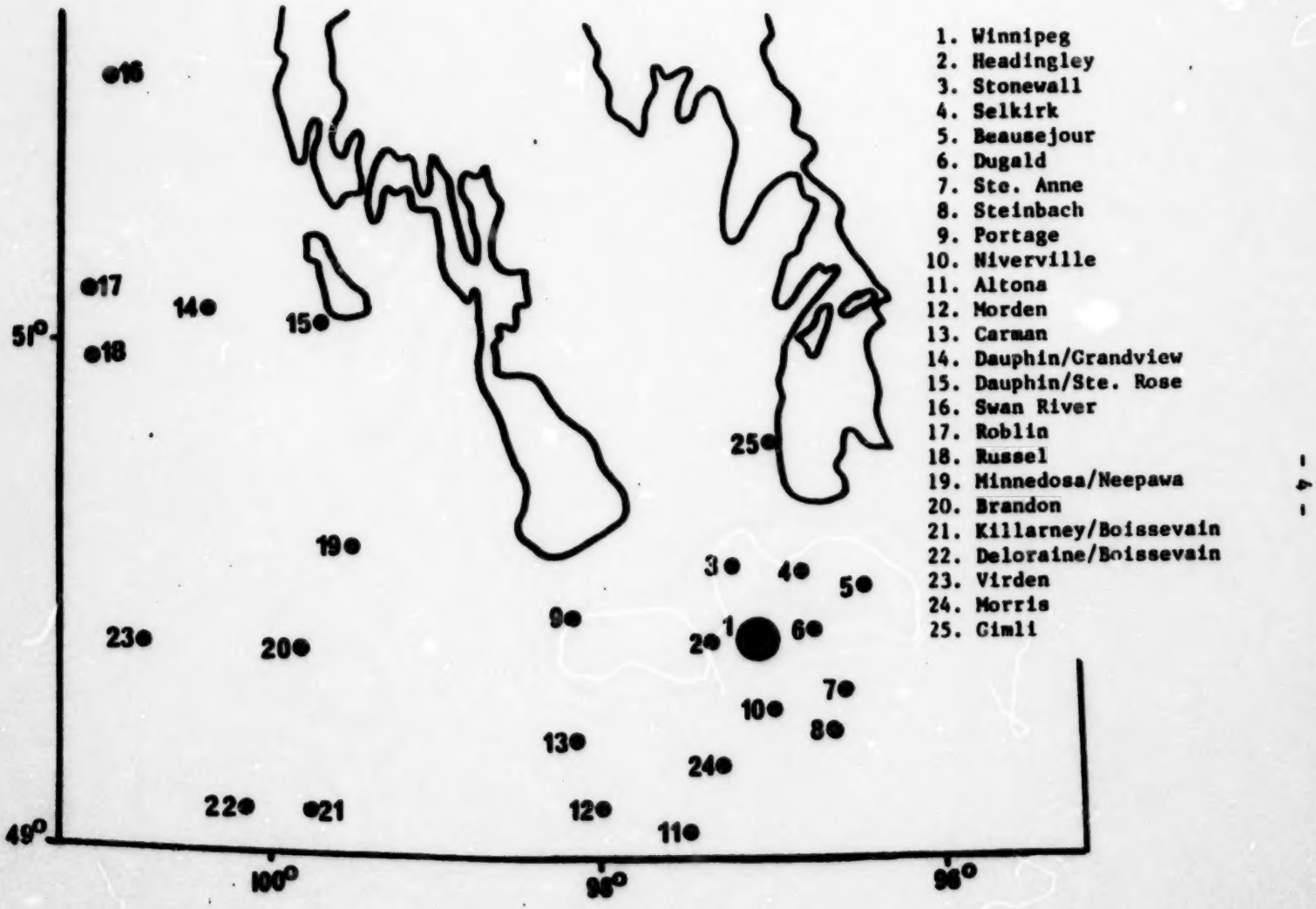

FIGURE 1. BIRD SAMPLING LOCATIONS IN SOUTHERN MANITOBA, 1983

RESULTS AND DISCUSSION

Table 2 presents the dates of collection at the different sites, a summary of the catch success, and the analytical results. Details about the positive samples are given in Table 3. Of the 259 tested samples, 17 (7%) were positive. Two of these were pooled samples, from two birds in each case, but it is unknown whether one or both of the birds carried antibodies. HI antibody titres of 1:10 were detected in 5 cases, titres of 1:20 and 1:40+ in 6 cases each. Five of the positive samples were taken from juveniles, twelve from adults. Juvenile birds in this study are those distinguished as such by plumage, i.e., recently fledged birds. The degree of skull ossification was not determined, therefore, some of the 1983-born birds are probably included in the adult category.

Not all species of birds possess the same susceptibility to infection by the encephalitis virus (Wheeler 1966, Meet. Am. Epidemiol. Soc., San Fransico, Calif., cited by Hayes and Wallis 1977). For this reason, as well as because of the different species composition of the bird populations at the different sampling sites, the most meaningful comparisons and conclusions would be those based on consideration of a single species -- in our case, the house sparrow.

Comparison with the percentage positive of all birds shows very little difference: 15 of 188 sparrow samples (8%) were positive (10 of 128 adults, 5 of 60 juveniles; 8% in both cases). Titres of 1:10, 1:20 and 1:40+ were found in 5 cases each (Table 4).

Antibodies which develop in the blood of the birds may persist for several years or a lifetime. It is therefore not possible to differentiate between those adult birds which came into contact with the virus in 1983 and those which may have carried the antibodies from previous years. Juvenile birds with antibodies would have become infected in 1983. The work of Holden et al. (1973 b) indicated that the HI antibody titre may slowly decrease over the years subsequent to the infection. The higher incidence of the 1:10 titres in adults compared to the higher incidence of high titres in juveniles would thus suggest that at least some of the adult birds carried antibodies acquired prior to 1983; however, the percentage of positive samples in adults and juveniles was identical, which would suggest that most birds probably did contract the virus during the current year.

Birds which had been in contact with the WEE virus were found in 11 of the 25 communities. The highest percentages of positive samples came from Killarney/Boissevain (3 of 12), Russell (2 of 8), and Headingley (1 of 4). In Portage la Prairie, one of the three house sparrows was positive, but none of the five other birds of different species collected there carried antibodies. Apparently, the Killarney/Boissevain area had the highest incidence of positive birds, but the sample sizes are not large enough to permit proper comparison between the communities.

Available literature shows a considerable variation in the WEE prevalence in different areas. Hayes and Wallis (1977) reported the proportion of positive birds from several earlier studies from the Eastern USA ranging from 8 to 40 percent. They provide no information

on any associated occurrence of the disease in humans. Data from Saskatchewan (Burton et al. 1966) and Texas (Holden et al. 1973 a) compare the antibody prevalence in birds during years when human cases of WEE were recorded with years without human cases (Table 5).

Generally, the Manitoba data are lower than what has been reported elsewhere. However, considering the range of the reported percentages, the possible geographical differences, as well as the differences in methods and interpretation (e.g. what is considered an "epidemic" year, or at what titre is a sample "positive"), it becomes obvious that the data are not directly comparable. In addition, the bird population densities probably play a significant role in the virus transmissions (Dr. J. Iversen, Western College of Veterinary Medicine, pers. comm.). As the present survey was conducted after the mosquito spraying took place, the virus spread may have been arrested to some extent, which would contribute to lowering the antibody prevalence. Ideally, a series of results from Manitoba, collected over several years, would provide the best comparison. Starting the surveillance early would give a better indication of the virus activity, because viremic birds may be found earlier in the season during epidemic years as opposed to non-epidemic years (Holden et al. 1973 a). Weekly increases in the antibody prevalence have been associated with subsequent outbreaks of the St. Louis encephalitis, another arboviral disease (U.S. Department of Health 1976).

Monitoring of birds is a surveillance method which can provide, at a modest expense, a substantial amount of data from a wide area, and thus furnish an additional base of information needed for decisions regarding the disease control measures.

SUMMARY AND CONCLUSIONS

1. Antibodies to WEE were found in birds from 11 of the 25 sampled communities, including the City of Winnipeg.

2. The antibodies were found in 8 percent of 188 house sparrow samples (in 7 percent of 259 bird samples in total). It was concluded that most (although not all) of the birds acquired the infection during 1983.

3. The antibody prevalence was lower than is generally reported from other areas. The spraying for mosquito control may have contributed to the low prevalence, however, meaningful interpretation of the 1983 data is limited by the lack of comparable Manitoba information from other years.

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TABLE 1. SUMMARY OF WNE MONITORING IN BIRDS; BY SPECIES

		No. of Birds Caught		No. of Samples Submitted		No. of Samples Tested		No. of Samples Positive
		n	%	n	%	n	%	
House sparrow *Passer domesticus*	Adult	167		142		128		10
	Juvenile	85		68			60	5
	Total	252	71.8	210	70.5	188	72.5	15
Smaller sparrows *Fringillidae*		36	10.3	27	9.1	19	7.3	
Feral pigeon (rock dove) *Columba livia*		32	9.1	32	10.8	29	11.2	1
Wilson's warbler *Wilsonia pusilla*		5	1.4	4	1.3	2	0.8	
Downy woodpecker *Dendrocopus pubescens*		4	1.1	4	1.3	4	1.5	
Wren *Troglodytes* sp.		4	1.1	4	1.3	2	0.8	
Vesper sparrow *Poocetes gramineus*		3	0.8	2	0.7	2	0.8	1
Bronzed grackle *Quiscalus quiscula*		3	0.8	3	1.1	3	1.1	
American goldfinch *Spinus tristis*		2	0.6	2	0.7	2	0.8	
Eastern kingbird *Tyrannus tyrannus*		2	0.6	2	0.7	1	0.4	
Baltimore oriole *Icterus galbula*		2	0.6	2	0.7	2	0.8	
Hermit thrush *Hylocichla guttata*		1	0.3	1	0.3	1	0.4	
Barn swallow *Hirundo rustica*		1	0.3	1	0.3	1	0.4	
American robin *Turdus migratorius*		1	0.3	1	0.3	1	0.4	
Purple finch *Carpodacus purpureus*		1	0.3	1	0.3	1	0.4	
Catbird *Dumetella carolinensis*		1	0.3	1	0.3	1	0.4	
Blue jay *Cyanocitta cristata*		1	0.3	1	0.3	1	0.4	
	Total	351	100.0	298	100.0	259	100.0	17

TABLE 2: SUMMARY OF WEE MONITORING IN BIRDS; BY AREA.

Area	Date	No. of Samples Collected	No. of Birds Involved	No. of Species	No. of Samples Analyzed	No. of Positive
Winnipeg						
St. James	26/07/83	5	5	1	5	0
St. James	01/08/83	7	7	2	7	0
River Heights	02/08/83	6	6	1	6	0
St. James, River Heights	08/08/83	20	20	3	20	0
Weston, St. James	09/08/83	11	11	1	11	0
St. James	10/08/83	3	3	1	3	0
Weston	13/10/83	1	1	1	1	1
Winnipeg Total		53	53	3	53	1
Headingley	03/08/83	6	7	2	4	1
Stonewall	04/08/83	13	19	1	7	0
Selkirk	04/08/83	6	6	1	4	0
Beausejour	08/08/83	14	15	1	13	2
Dugald	08-09/08/83	8	10	2	4	0
St. Anne	10-11/08/83	9	11	3	5	0
Steinbach	11/08/83	12	22	2	10	0
Portage	15/08/83	10	12	5	8	1
Riverville	16/08/83	8	11	3	5	0
Altona	17/08/83	5	5	3	3	0
Mordon	17/08/83	11	12	8	10	0
Carman	18/08/83	13	18	1	12	2
Dauphin/Grandview	24/08/83	11	15	2	10	0
Dauphin/St. Rose	24/08/83	10	10	3	7	0
Swan River	25/08/83	17	20	2	17	1
Roblin	26/08/83	9	9	2	9	0
Russell	26/08/83	9	9	2	8	2
Minnedosa/Neepawa	30/08/83	11	13	2	10	1
Brandon	30/08/83	10	11	2	9	0
Killarney/Boissevain	31/08/83	13	13	2	12	3
Deloraine/Boissevain	31/08/83	10	10	1	10	1
Virden	01/09/83	11	13	3	10	2
Morris	07/09/83	9	10	2	9	0
Gimli	14/09/83	10	17	2	10	0
TOTALS		298	351	16	259	17

TABLE 3: BIRDS SEROPOSITIVE TO WEE

Sample Location	Species	Sex/Age	No. of individuals in sample	HI Titre
Headingley	House sparrow	male ad.	1	1:10
Beausejour	House sparrow	male ad.	1	1:20
Beausejour	House sparrow	male ad.	1	1:10
Portage la Prairie	House sparrow	female ad.	1	1:40+
Carman	House sparrow	male ad.	1	1:10
Carman	House sparrow	female ad.	2	1:20
Killarney/Boissevain	House sparrow	female ad.	1	1:40+
Killarney/Boissevain	House sparrow	female juv.	1	1:20
Killarney/Boissevain	House sparrow	female ad.	1	1:10
Deloraine/Boissevain	House sparrow	female juv.	1	1:40+
Minnedosa/Neepawa	House sparrow	female juv.	1	1:10
Virden	Vesper sparrow	ad.	2	1:40+
Virden	House sparrow	female juv.	1	1:40+
Russell	House sparrow	male ad.	1	1:20
Russell	House sparrow	female juv.	1	1:20
Swan River	House sparrow	female ad.	1	1:40
Winnipeg	Feral pigeon	male ad.	1	1:20

TABLE 4. HI ANTIBODY TITRES OF HOUSE SPARROWS

Titre	Juveniles		Adults		All	
	n	%	n	%	n	%
1:10	1	20	4	40	5	33
1:20	2	40	3	30	5	32
1:40+	2	40	3	30	5	33
Total	5	100	10	100	15	100

TABLE 5. WEE ANTIBODY PREVALENCE REPORTED FROM OTHER JURISDICTIONS

Area	Year	Antibody prevalence (sample size) In sparrows	In all birds	Human cases recorded	Authors
Saskatchewan	1962	20% (44)	13% (232)	no	Burton et al, 1962[1]
	1963	26% (72)	22% (234)	yes	
Hale County, Texas	1965	55% (22)		yes	Holden et al 1973 a[2]
	1966	56% (78)		yes	
	1967	45% (155)		no	
	1968	39% (150)		no	
	1969	36% (270)		no	

1 Neutralizing antibodies

2 HI antibodies